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ABSTRACT

In November 1997, Washington University and the Parents as Teachers National Center hosted a forum on how to apply neuroscience research to the field of education. The forum focused primarily on language acquisition in young children, which is fundamental to early learning and development and to later school success. The 110 participants included educators, scientists, educational psychologists, legislators and policy makers, education and neuroscience researchers, foundation representatives, superintendents of public instruction, leaders of various education organizations, and representatives of the media. The forum included presentations by leading researchers in the fields of brain research and language development, case studies by leaders of two states and one community that are using innovative approaches to meet the needs of young children and their families, and dialogue among participants on areas of consensus, strategies for action, and topics for further research. This report summarizes the forum's presentations and participants' recommendations. Articles and summaries are grouped in the following areas: (1) "What Do We Know about How the Brain Develops and How Children Learn Language?"; (2) "How Can This Information Best Inform Policy and Practice?"; (3) "Case Studies: Statewide and Communitywide Collaborative Efforts"; (4) "Rob Reiner's 'I Am Your Child Campaign'"; (5) "Points of Commonality and Controversy"; and (6) "Putting It All Together: Challenges and Mandates." (EV)

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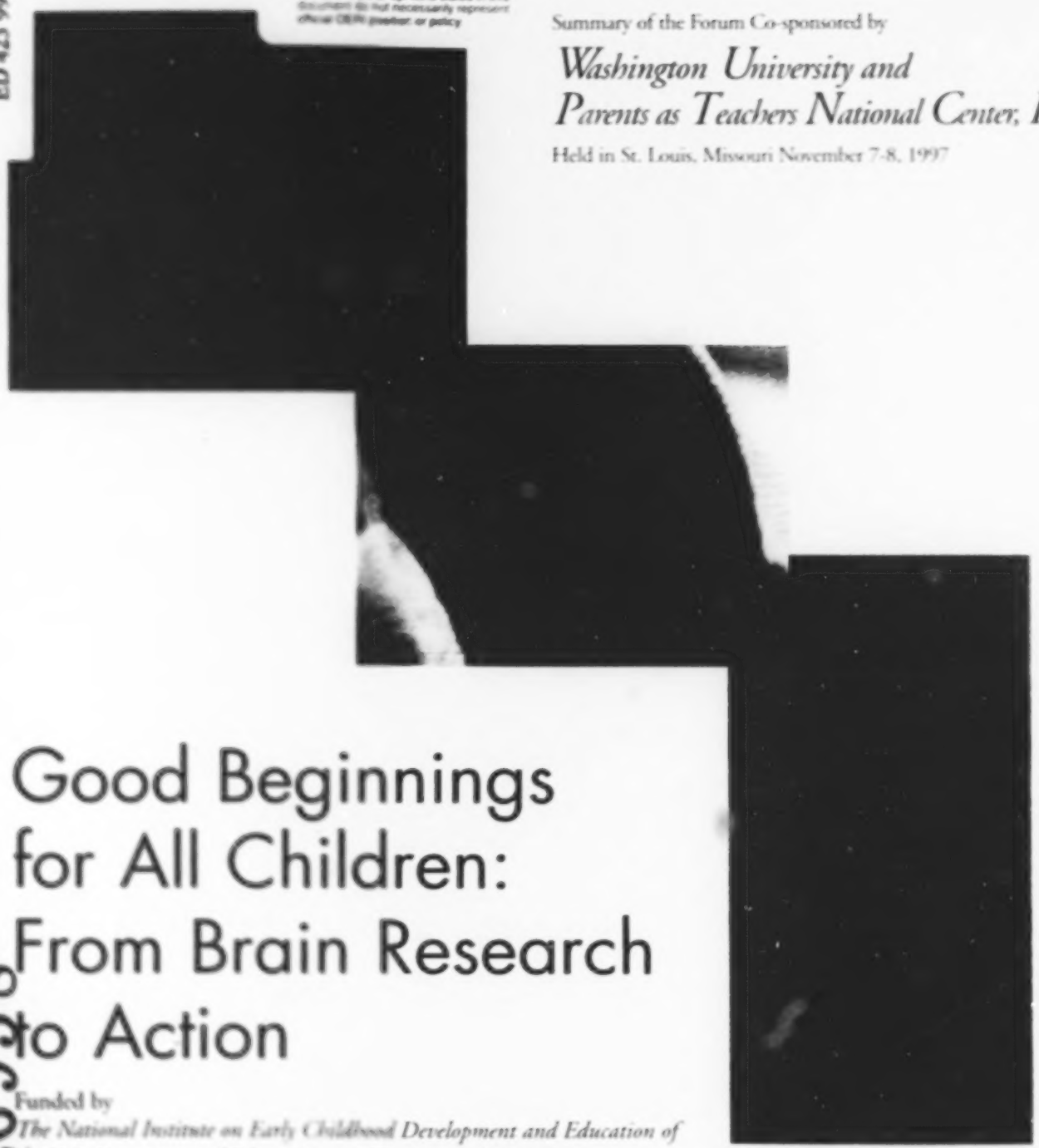
Summary of the Forum Co-sponsored by

Washington University and Parents as Teachers National Center, Inc.

Held in St. Louis, Missouri November 7-8, 1997



Good Beginnings for All Children: From Brain Research to Action

Funded by
The National Institute on Early Childhood Development and Education of the U.S. Department of Education and The Danforth Foundation

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10 What is most significant is that at birth, the brain is still in the process of doing a lot of "dynamic wiring" that can be influenced by experience.

Whether a child knows 30 words or 600 words at 24 months is a direct function of how many words he's heard.

Brain research should help focus more attention on the importance of providing services to the youngest children.

Every institution that has anything to do with children...

24 must make a commitment to conduct its business with one question in mind: "Is it good for the children?"

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Rob Reiner's "I Am Your Child Campaign"

Points of Commonality and Controversy

Putting it All Together: Challenges and Mandates

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We are grateful to the members of the National Planning Committee for their assistance in planning and executing the Forum. We are indebted to Jeff Lichtman for serving as "master of ceremonies" during the two-day meeting.

Report Writer: Deborah L. Cohen
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Preface

Most parents aren't aware that at birth, infants have the ability to perceive the sounds found in all languages—a skill that fades away as they are socialized in a single language. They may also not know that if a baby has certain visual problems that aren't corrected early, they can't be repaired and restored to health the way an adult's could.

Early childhood educators have toiled for years to impress upon policymakers that the years before formal schooling have an indelible effect on children's healthy development and potential to succeed. Today, neuroscientists can offer dramatic evidence to support that claim. A growing body of research is shedding new light on the effects early experiences have on the development and functioning of the brain. If harnessed properly, the power of these findings could help fuel a new generation of investments in early childhood education, parenting education, and family support. A fundamental challenge, however, is bringing educators and scientists together to interpret the research and apply it to the learning enterprise.

The Parents as Teachers program, launched in Missouri in 1981 and since adopted by communities across the United States and abroad, has staked its reputation on the assumption that parents are children's primary and most powerful teachers. The program uses home visits by trained parent educators to coach new parents on how to talk to, touch, nurture, and stimulate learning in their infants and toddlers. The Parents as Teachers National Center (PATNC), which administers the program and provides training for parent educators nationwide, is keenly interested in applying neuroscience research to early childhood and parenting education. With funding from the Charles A. Dana Foundation and the Robert R. McCormick Tribune Foundation, PATNC is piloting a new curriculum that incorporates neuroscience research in Parents as Teachers programs in St. Louis and Chicago. The neuroscience-enhanced curriculum was developed with a team of neuroscientists from Washington University School of Medicine.

On Nov. 7-8, 1997, Washington University and the PATNC hosted a forum on how to apply neuroscience research to the field of education. The forum focused primarily on language acquisition in young children. Language acquisition is fundamental to early learning and development and to later school success. It is an area of great interest to educators and education policy-makers alike. And, perhaps more so than any other area of development, research on language acquisition by neuroscientists and cognitive psychologists has quite direct implications for parents and educators of young children, as well as for those setting the education agendas for these young children. The 110 participants who attended by invitation included educators, scientists, educational psychologists, legislators and policymakers, education and neuroscience researchers, foundation representatives, superintendents of public instruction, leaders of various education organizations, and representatives of the media.

Mark Wrighton, Chancellor of Washington University, officially opened the Forum by welcoming the participants. Wrighton said the University was pleased to play a role in the Forum, and in the neuroscience project with PATNC. He finds it an exciting prospect that fundamental research in neuroscience can aid us in assisting our children. Programs such as this Forum, he said, can make enormous contributions by bringing together people with diverse interests to try to bridge the gap between the science taking place in the laboratories and what's actually happening in people's homes.

The National Institute on Early Childhood Development and Education of the U.S. Department of Education and the Danforth Foundation jointly sponsored the event.

The Forum was an exciting mix of informative presentations by leading researchers in the fields of brain research and language development, case studies by leaders of two states and one community that are using innovative approaches to meet the needs of young children and their families, and dialogue among participants to discuss areas of consensus, strategies for action, and topics for further research.

The Forum provided much food for thought and generated many suggestions on steps needed to apply all this information in way that will benefit young children. This report summarizes the presentations and the participants' recommendations.

Missouri Governor Mel Carnahan described some of the initiatives his state has undertaken to invest in the early years of children's lives.

Message fr

Missouri's Mission: Parents as Teachers and More

The Governor summarized his philosophy by quoting from a writer who talked about how each day and with each word, touch and action, we make deposits in the memory books of our children. The neuroscience research merely confirms that learning starts at birth, and that the brain develops through experience.

The Governor expressed his pride in Missouri's Parents as Teachers program, which started at four pilot sites and has expanded across the state. It has also been replicated in 48 states, the District of Columbia, and six foreign countries. Although the program was started two administrations back, Governor Carnahan's administration has committed the funds to expand it and make it as widely available as possible.

Another important program is the state's "Educare" program, a component of its welfare reform plan that helps home day care providers get training, licensing, and accreditation so they can provide the best possible services for young children.

In January, 1998, the Commission on Early Childhood Care and Education, appointed by Governor Carnahan, presented its recommendations. Based on these recommendations, the Governor will propose an action plan to the Missouri legislature with the following goals: to expand the availability of affordable child care; improve the quality of child care; and provide developmental outreach during the first critical three years of life.

- **Expand the availability of affordable child care.** Legislation will be proposed to establish a grant program that encourages public schools to establish quality care for preschool children age three and up. The proposal also includes funds to increase access to child care for low-income families, particularly those moving from welfare to work. Businesses will be granted state income tax credits for providing donations to non-profit organizations that support child care.

- **Improve the quality and safety of child care.** To improve the quality and safety of child care, a proposal will be put forward to provide incentives for quality child care; expand continuing education for child-care providers; and require all child-care workers in "registered" facilities submit to child abuse and neglect and felony screenings.

- **Provide developmental outreach during the first three years of life.** The plan expands outreach programs such as Parents as Teachers, the Healthy Children and Youth Program, and the First Steps Program. A priority is to offer developmental screenings for all Missouri children under the age of two. Brain research confirms that early detection and treatment of delays and problem are critical to proper child development.

These initiatives are directed at giving Missouri's children the opportunities they need for success by giving them a strong start.

m Missouri

Missouri Commissioner of Education Robert Bartman spoke of the phenomenal implications that brain research has for the educators and policy makers who make decisions about our children's early education.

A Message to Educators and Policymakers

The technology available today opens up wonderful opportunities to think anew about how children learn, grow, and develop and the effect experience has on them. Further, brain research has phenomenal implications for educators and policy makers. The research implies that no child is born with his or her place established on the bell-shaped curve. All children are born with the same number of brain cells. But if a child's brain isn't nourished with rich environmental stimuli as well as good nutrition, some important brain connections don't get made. How a child's brain gets wired depends on what happens to that child during the critical early years.

That's why early childhood family education and support programs like Parents as Teachers aren't just important, they are essential. Parents as Teachers is based on two simple truths - that babies are born learning and that parents are their first and most influential teachers. The program supports parents in giving their children the best possible start in life. And the program has become even more cutting edge recently. It now incorporates the latest neuroscience findings on early learning and translates them into concrete "what," "when," "how," and "why" advice for parents of children birth to age three.

With so many children being cared for outside the home, it's absolutely essential that parents be supported in their efforts to provide their children with a stimulating, enriching, loving environment. All boards of education and school districts must take full advantage of the availability of programs such as Parents as Teachers -- it is basic for the growth and development of young people. The earliest years are when the brain connections are made that allow children to understand, read, get along in their environment, and make decisions.

New resources need to be found and other reallocated to assure that all children have a fair start. The data cry out for policies to focus on quality of child care, expansion of Parents as Teachers, and quality of preschool programs.

Commissioner Bartman expressed his hope that the policy makers and educators attending the Forum would take what is learned and use it to help better educate all children and make them more productive citizens.

The Potential Role of Neuroscience Research in Education Reform

The work of today's neuroscientists is relevant to both early childhood education and the socialization of young adults. First, it offers dramatic evidence that appropriate stimulation in infancy has a profound impact not only on physical development, but on a child's emotional stability and ability to handle the challenges in life. The research also shows that experiences in utero and early infancy can damage the growth of the brain and compromise intellectual and emotional functioning.

The Good News. Much of the damage that can occur in pregnancy and early infancy is preventable. States can support campaigns and programs to stem behaviors that jeopardize children's health and well-being beginning in the womb and beyond--from smoking, drug and alcohol abuse, and teenage pregnancy to lead poisoning, malnutrition, and child abuse and neglect. Parents are clearly the first line of defense and need to be at the center of these education efforts, but it is equally important to make sure caregivers get the training they need and are held accountable to high standards of quality.

The Challenges. Generating the public will to make investments on the scale that is needed is a challenge. There is an anomaly in this country's priorities when it comes to education funding. Neuroscience research tells us that the stakes in terms of positive outcomes are highest in a child's first years of life--exactly the reverse of where this nation puts its top education dollar. Caregivers tending the youngest children receive the least compensation, training, and education, while the highest salaries and most sophisticated training go to professors at the Ph.D. level.

Emerging research on the brain has implications not only for training and compensation, but for how and when we teach subjects like reading and foreign languages. Schools need to be willing to adapt their schedules and methodologies to coincide with these critical windows and patterns of learning, rather than

simply saying "we've always done it this way." There are also potential benefits of neuroscience research for developing early intervention strategies to keep children out of special education.

Graduate schools of education need to do a better job of incorporating neuroscience research into teacher training. Collaboration between parents and teachers and across disciplines is critical, and agencies and communities need to work together to assume responsibility for channeling resources to children under age three.

A key challenge is making sure that the people who stand to benefit most have access to the information they need to apply neuroscience research to their own lives. That means targeting not just the parents who read *Newsweek*, but the 16-year-old who is poor, pregnant, and has no resources.

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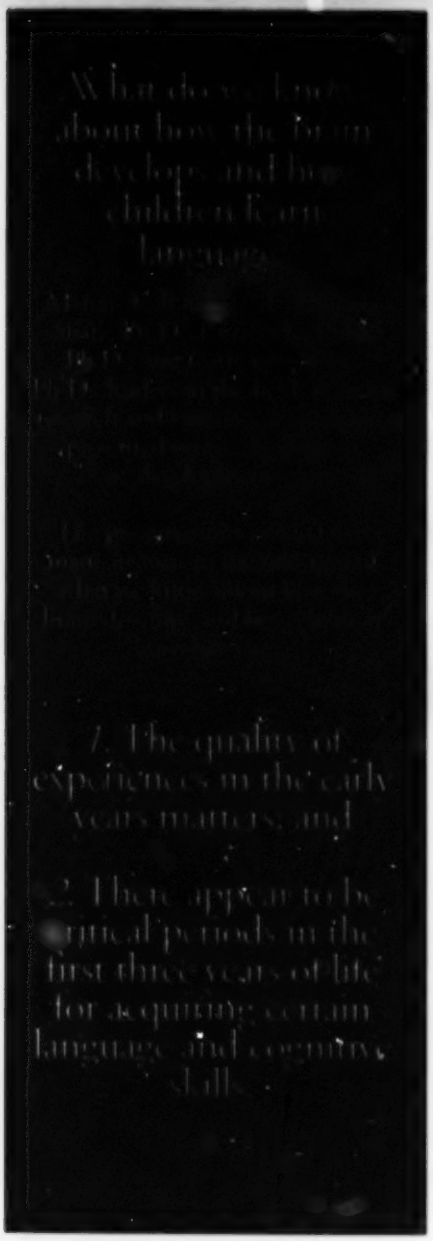
What do we know about how the brain develops and how children learn language
1. The quality of experiences in the early years matters, and
2. There appear to be critical periods in the first three years of life for acquiring certain language and cognitive skills

Section One

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Unraveling the Mystery: Technological Breakthroughs

Marcus E. Raichle, M.D.
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An Explosion in Technology. In the past 20 years, there has been an "explosion" in technology to help scientists understand how the brain is organized. CT scans (formally known as X-ray-computed tomography), PET (positron emission tomography), and MRIs (magnetic resonance imaging), have made it possible not only to look at the brain but to visualize what different parts of the brain are doing and to study specific areas involved in specific tasks.

Neuroscientists today use the various scanning technologies to look at slices of the brain and to compare images of the brain reacting to different stimuli. A PET image of a brain exposed to a vivid checkerboard pattern differs from that of a brain not receiving that kind of visual stimulation. You can see the higher blood flow in the one with the stimulation. Neuroscientists often use this technique of "subtracting" the difference between one image and another to determine how and in what part of the brain particular activity occurs.

How the Brain Processes Speech. Neuroscientists use various kinds of experiments to try to understand how the brain processes speech. The experiments involve scanning the brains of individuals being exposed to words in various stages--for example, hearing the word with their eyes closed, opening one eye, reading the word on a monitor, and being asked to provide a verb that matches the *noun* on the screen. Scanning techniques make it possible to see more areas of the brain becoming active as each new level of complexity is added to the task of word recognition.

Popular theories that suggest the brain is divided up into areas each with a specific function are misleading. Instead, brain

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functioning can be likened to a symphony orchestra, which has a finite number of players but can produce an infinite number of sounds. When it comes to language acquisition, neuroscientists are a long way from being able to understand how multiple areas of the brain interact. Another similarity to a symphony orchestra is that not every player performs at the same time. One interesting finding of these scanning experiments is that the minute the subject begins to attend to words, other areas of the brain--such as those related to emotions--appear to shut down. This phenomenon suggests that while complex tasks are enlisting more areas of brain activity, they are also "subtracting" other functions.

In another experiment, people were asked to generate verbs rapidly in response to a series of nouns. Once the subject is taught to associate a particular verb with each noun, the brain appears to organize itself differently so that it can respond automatically each time it sees that noun. The areas of the brain that were first used to learn the task itself actually "check out," while new areas come into play to respond automatically. This pattern suggests that the brain uses one system for tasks that are new and different and novel and switches to another system when a task becomes rote. The human mind is more likely to use this "automatic pilot" mode of activity at certain times and under certain conditions--such as infancy, aging, and times of stress. It makes sense that infants would rely more on automatic responses because other systems of learning have not yet matured.

Neuroscientists have a long way to go to understand how the different parts of the brain interact in learning subjects like reading and mathematics. Further, the areas of the brain that quiet down during certain tasks may have as much to teach us as the areas that become active. What you see now may not be what you see 10 minutes later for the same task--it's a marvelously complex system that is on the move.

There is reason to be optimistic that advances in cognitive science will help speed the process of neuroscience research

The shift in neuroscience research from looking primarily at the damaged brain to putting together an owner's manual for the normal brain will have tremendous benefits for the educational world.

changing educational theory. The shift in neuroscience research from looking primarily at the damaged brain to putting together an owner's manual for the normal brain will have tremendous benefits for the educational world.

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Wiring the Brain for Vision: Critical Connections

Neuroscientists estimate there may be a trillion neurons in the brain supporting as many as 1,000 trillion connections at a minimum. One can use the analogy of a telephone system to explain how neurons transmit and receive information. The brain uses a combination of electrical and chemical signals to essentially place phone calls from one nerve cell to the other. Information from the receiving to the sending end of nerve cells travels through a cable-like structure called the axon. The connection that each nerve cell makes with other nerve cells at the end of that cable is called a synapse. When the signal from one nerve cell reaches the end of the other, it is transmitted across a gap by chemicals.

A section of the brain the size of a grain of rice contains about 10,000 nerve cells capable of making a thousand connections each, amounting to a total of 10 million connections. It is as if nothing has been left to chance.

In the developing brain, two different mechanisms cooperate to put this wiring system in place. The first mechanism is controlled by the genes. A genetic blueprint essentially establishes or "hard wires" a trunkline between two different cities in the brain. Once the connection gets to the right destination city in the brain, another mechanism governed by neural functioning makes sure the connection reaches a specific house, so to speak. It is similar to making a phone connection between your phone in New York and your grandmother's phone in Washington, D.C.; you want your grandmother's phone in Washington to ring and not everyone else's. This combination of "hard wiring" by the genes and "sculpting" through a dynamic neural process allows for adaptability and environmental influences.

The knowledge we have about the brain's wiring system comes from 30 years of work studying human and animal brains. We are basically eavesdropping on the functions of the brain. Imaging techniques have made it possible to look at thousands

of cells in the human brain--a process that is like listening to individual phone calls.

Shifting more specifically to the visual system, light comes into the eyes and hits the rods and cones, which have a special pigment in them that absorbs light and turns this light energy into an electrical signal. This signal triggers the process of "phone calling" from one cell to the next. The "output" cells of the eye, called ganglion cells, form a large cable that collects about one million nerve fibers, which is called the optic nerve. The optic nerve sends information from both eyes to both sides of the brain. The information is not sent randomly, but in a highly ordered and specific structure of connections from one eye to one set of cells.

It is reasonable to wonder why, if we have two eyes each making its separate connections, we don't see double. What happens is that the brain combines two sets of views into one vision through a layering process. The layers are cut up and "interdigitated" to form little stripes in what is known as the visual cortex. Using special tracing techniques, researchers have been able to view how each eye essentially alternates its information to the cortex. The tracing technique makes it possible to see the striped pattern in an animal's brain, indicating this alternating pattern.

The significant point for educators and early childhood specialists is that this beautiful, even subdivision of the cortex into right-left, right-left is something that can be influenced by early experience. Whereas an elderly person can have cataracts corrected after 10 years and still see normally, a baby born with cataracts left untreated for several years remains blind and cannot be restored to normal vision. To understand this phenomenon better, researchers have conducted experiments such as taking a cat or a monkey and closing up one of its eyes. If the eye is closed up when the animal is a newborn, the tracing technique shows that almost all of the target cells have been taken over by the eye that was being used, while the other eye has literally lost its connections with the target cells. It is as if almost no phones are ringing in the eye that was closed, so that that eye can only perceive diffuse light. These experiments, conducted by David Hubel and Torsten Wiesel, scientists who won the Nobel Prize, still offer the best example of how experience can affect brain wiring.

> What is most significant is that at birth, the brain is still in the process of doing a lot of "dynamic wiring" that can be influenced by experience.

These experiments have given rise to the groundbreaking notion that this kind of effect of abnormal wiring is confined to a critical early period. This knowledge has prompted the medical profession to treat optical problems in children very early instead of waiting until they get older.

The research just described offers evidence that the inputs that are being used and are more active are strengthened, and the inputs that are not used are weakened. To explain how this process works in the visual system, consider fetal development. In the developing fetus, the eye initially is not even connected to the brain. Using the phone line analogy again, the connections must be made in such a way that signals get sent not only to the right city, but the right house. Rather than sending the signals in the orderly layering fashion that occurs in adult vision, the signals are being sent all over the place in the developmental stage. Over time, through a remodeling of connectivity, this imprecise system of signals emerges into the more precise adult pattern. In the developing brain, an individual phone can be made to ring from a number of places, whereas in an adult it can only be made to respond if the appropriate eye is sending the message.

The connection between the eye and the brain is completed by the end of the first trimester. But the rods and cones needed to place the phone calls, so to speak, are not present until the second half of gestation. Even without the rods and cones, however, the ganglion cells are spontaneously placing phone calls to the brain at a rate of once a minute in utero. Using special dyes, researchers have been able to observe this process

of phoning and compare the sort of random calling that occurs in early development to the more precise signal-sending that occurs in adulthood. If signals do not receive a response, as occurs in the developmental stage, eventually those connections are removed. Slowly, over time, the inappropriate connections are eliminated, and the ones going to the right area are strengthened.

To determine if this developmental "autodialing" process is really necessary, researchers have used certain kinds of drugs to block this phoning from happening in animals. This kind of experiment has demonstrated that the initial "autodialing" activity is required for the adult connectivity pattern to emerge. These findings highlight the potential dangers of any agent that might interfere with the phoning, like drugs that cross the placenta.

When a child is born, the wiring of the visual system is not yet complete, and the "autodialing" activity helps to refine the connections. Although the "autodialing" feature is replaced by vision at birth, the system continues to be refined and fine-tuned by experience. Once the wiring is complete and all the appropriate connections have been formed, experience can no longer alter these connections. This finding has given rise to the notion that there are critical periods in which experience can have an impact on how the system develops--but that once those periods are over, the visual system is in effect "hard wired." This dynamic is not present in all aspects of brain activity; for many kinds of activities, these windows of influence remain open so we can continue to learn and remember.

In the brain's process of phoning, things like the country code and the area code are determined by a hard-wired genetic blueprint. But choosing from two million target phones which one to connect to requires a dynamic process of "autodialing" that involves neural function--first, in the form of the spontaneous phoning activity, and then in the form of experience. There is evidence that this type of spontaneous activity used to refine the connections in the brain takes place in other systems of the brain, such as the spinal cord and the auditory system.

Implications for Early Childhood Education. What is most significant is that at birth, the brain is still in the process of doing a lot of dynamic wiring that can be influenced by experience. It is not clear that vision, specifically, can be improved through the right kinds of early experiences, but it is clear that deprived experience causes a loss. Clearly, there is a critical period during which the visual system is most vulnerable to outside influences. If there are similar critical periods for acquiring various cognitive skills, this knowledge could be of tremendous value in the policy arena.

Windows of Opportunity

There are critical periods during which experience has an impact on various aspects of development.

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Early Language Acquisition: The Brain Comes Prepared

Dr. Kuhl's research on how young children acquire language involves studying how infants from a variety of countries perceive sounds from other languages. Studies show that infants at birth are capable of perceiving sounds from ail languages, and that they lose that ability only after being exposed to a particular language over time. For example, one study showed that at age six or seven months, American and Japanese babies are equally good at discriminating between "r" and "l," even though the Japanese language has no "l" sound. By age 10 months, Japanese babies are having a much harder time making the distinction, while American babies have gotten much better at it. These findings suggest that the babies have started focusing on distinctions that matter to their specific language and ignoring the ones that don't.

Research shows that babies understand the sound patterns of language before words--at about 9 months. They also demonstrate a preference for the patterns of their own language over those of other languages by nine months. There is even evidence to suggest that before birth, the fetus is beginning to learn patterns of sounds and starting to prefer the mother's patterns to someone else's.

The baby's brain, when it is bombarded by speech, engages in a "mapping" process to organize the sounds it hears into categories. When we listen as adults, we literally tune out the sounds from other languages that we do not need. By this time, perception and experience have altered reality to create a system that can rapidly process information as it comes in.

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There is evidence that the baby's brain is not only listening for distinctions between sounds at an early age, but differentiating what the mouth looks like when various sounds are pronounced. One study shows that 18-month-old babies clearly directed their attention to an adult silently mouthing a sound being played over a loudspeaker, ignoring other adults who were mouthing different sounds.

Another series of experiments compared how babies and adults in different countries perceive sounds and groups of sounds. These studies offer powerful evidence that infants gain information about which sounds are relevant well before formal education begins—simply by being raised in one country as opposed to another. Babies, without talking or offering any obvious signs that the brain has captured information out there in the air are nonetheless listening in meaningful ways.

Research has also shown that adults instinctively help babies learn by raising the pitch of their voices an octave and speaking slowly and in an exaggerated fashion -- what we call "Parentese". In one recent study, which involved 30,000 measurements of vowels spoken by mothers in Russia, America, and Sweden, mothers expanded the vowels in their words when they talked to infants. These findings suggest that the baby is attracted not only to a mother's coo, but to her use of sounds that are easier to hear and produce. Infants as young as 12 weeks old will "coo back" the same sound that their mother is pronouncing if they are given enough time. The bottom line? Parentese is good for babies.

The kind of brain mapping that occurs in the early months of life alters our ability to hear distinctions in speech that we once were capable of hearing. Although it is not impossible to acquire new languages in adulthood, it is much more difficult than in infancy. For example, it takes years of studying English for Japanese adults to distinguish between l and r, even when they have a great deal of motivation to do so. One direct implication for the education system is that spending money on teaching high schoolers languages doesn't make nearly as much sense as spending money on teaching them to preschoolers.

> Academics, legislators and business people are all beginning to recognize how vitally important it is to use knowledge on the workings of the brain to improve human and national productivity.

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Language, Literacy, and Social Class: Experience Matters

Dr. Snow prefaced her remarks with the assumption that while children bring some innate capacity to the task of learning language, it is by and large a function of social interaction subject to enormous individual and cultural differences.

Children who know a lot of words are generally considered smart and do well in school, while a limited vocabulary can be an indicator of developmental delay and low achievement. Language acquisition occurs through the process of children engaging in conversation with adults, which presupposes a relationship and a level of engagement between the adult and the child.

Vocabulary development, the first step in the process, has a magically natural quality to it, but is remarkably slow in the beginning of a child's life. It usually takes a year for an infant to speak his or her first word, two to three weeks more for the second word, and six more months to learn a total of 30 or 40 words. Children accumulate words in a piecemeal fashion. Starting at about nine and a half months, an infant may gain a word, lose a word, and gain two words until about 13 months, at which time progress is more steady—about a word a week. Typically, when a child has learned about 50 words, he or she starts to show steady and exponential progress. It is almost as if the child suddenly realizes that this language business is indeed important and stops resisting it. The age at which that growth spurt begins varies widely, as does the type of words children learn—such as nouns or social expressions. The largest known study of word learning, which involved extensive interviews with mothers and caregivers, indicates that many children don't learn their first word until they are 12 to 14 months. By 13 months, the average child has acquired eight to ten words, and by 16 months the median amount is 30 to 40 words. There are, however, huge ranges around these median amounts.

Whether a child knows 30 words or 600 words at 24 months is

a direct function of how many words he's heard. The ideal context for learning words is having the parent point things out to the child and name them. Social class plays a tremendous difference in how well developed children's vocabularies are. There is good evidence for this from a longitudinal study, by Betty Hart and Todd R. Risley, of 42 children—13 from professional families, 23 from working class families, and six from welfare families. The study recorded vocabulary size over a three-year period, looking at how many different words parents and their children produced. The findings make it clear that the more words the parents produced, the more words their children learned. By age three, the children from professional families logged in 1,116 words, compared to 749 for the working-class children and 525 for the children from welfare families. At these rates of growth the children in the welfare group could be expected to master about 3,000 words by the time they reach age six, while the children from the professional group would have mastered 20,000. Those differences are massively important, because they represent not just how many words a child knows, but the domains of knowledge with which he is familiar.

The only way to acquire a 20,000-word vocabulary by age six is to be exposed to challenging words in a variety of contexts--including story-telling, reading with adults, playing, and mealtime conversations. A study that involved looking at all the rare words used in the household showed that when researchers observe the number of rare or sophisticated words used even in brief interactions between an adult and a three-year-old, they can predict significant differences in vocabulary level at age five. Mealtimes were particularly powerful for generating sophisticated words.

In addition, another important factor is "extended discourse"--the ability to produce narrative and explanations in collaboration with parents or other adults. Children's ability to talk in this way is, again, strictly a function of how much experience they've had doing it. Differences in extended discourse skills were evident in one study that compared middle and working class children in a laboratory school kindergarten

Whether a child knows 30 words or 600 words at 24 months is a direct function of how many words he's heard.

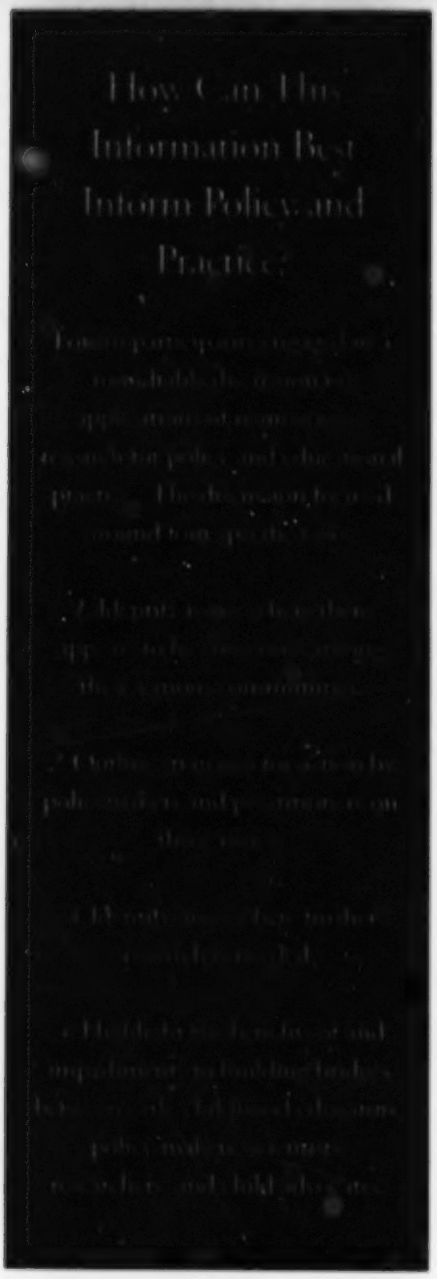
class. The study showed that the working class children had more difficulty writing their own names, reading simple words, and recognizing and defining words. While the middle class children might describe a car as something you drive that has four wheels, the working class children were more likely to offer a one-word association, like taxi.

Low-income children also scored well behind middle class children in a longitudinal study that measured grammatical abilities. The low-income children, who at age three years and nine months had grammatical capacities more in line with a 26 month-old, were acquiring grammar more slowly simply because of having had less exposure to language than their middle class peers.

The Impact of the Research on Literacy Development. Fourth grade reading ability offers a crucial benchmark for looking at literacy. In order to be literate, a child should be able to read interesting literature and informative texts in 4th grade. To predict how well a child is likely to do, you can use individual growth "slopes" that offer a sense not just of where the child started but of their pattern of growth and how slowly or quickly they are progressing. Using these kinds of growth slopes to track word recognition and extended discourse beginning at age five can offer a powerful predictor o 4th grade reading ability. The rate at which children acquire new words between kindergarten and 4th grade--which is eminently susceptible to influence from schools, parents, and out-of-school experiences--is extremely important to school success. One pattern these growth slopes reveal is that while working class children may start out reading at a level comparable to that of middle-class children, they often end up slowing down when reading becomes more related to oral language skills.

These data suggest that children's early experiences engaging in conversation with adults who are interested in the children and are willing to carry on conversations of interest to the children are crucial in producing vocabulary growth and other skills associated with language development and literacy. The most effective way to prevent literacy problems is to ensure that lower income children have access to the kinds of conversations middle class children are more likely to get at home. These efforts should involve educating parents, exposing children and their families to a broad range of interesting experiences, and offering much higher quality child care settings than many children currently experience.

In order to be literate, a child should be able to read interesting literature and informative texts in 4th grade.



Section Two

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Summary of the Roundtable Discussion

Issues On Which There Is Consensus

- Both heredity and environment matter in the development of children's brains; we can have the greatest impact on environment.
- There needs to be a national effort to provide all children with good nutrition, health care, and nurturing at home and in child care settings. The earlier the intervention the better.

Strategies For Action On These Issues

- Disseminate knowledge about brain research and its implications more widely to parents, educators, child care providers, civic and business leaders, and policy makers.
- Increase funding and accessibility of early childhood programs.
- Encourage collaboration among different groups.
- Build better support systems for parents.
- Increase efforts to eliminate behaviors and hazards that jeopardize children in utero and early infancy.

Research Questions That Need To Be Addressed

- Are there critical periods for learning language, mathematics, reading and other domains? How might research on critical periods be applied in the classroom?
- Is there a relationship between socio-emotional development and brain development?
- What intervention strategies are suggested by research on brain development?
- How might brain research be applied to conditions such as autism, learning difficulties, and behavioral problems?
- What are preventive factors to guard against poor nutrition, alcohol and drug use, and other conditions that have a negative impact on early brain development?

Benefits of and Impediments to Collaboration

Benefits of Collaboration

- Gain a better understanding of the work of various groups.
- Translate research into policy.
- Develop a "shared language."
- Increase understanding for a wide variety of audiences of the importance of early brain development.
- Provide better services for children.

Impediments to Collaboration

- Turf and territory issues
- "Inertia" - the attitude that "we've always done it this way."
- The inherent challenge of translating research into practical applications and the need for skilled translators.

There needs to be a national effort to provide all children with good nutrition, health care and nurturing at home and in child care settings. The earlier the intervention the better.

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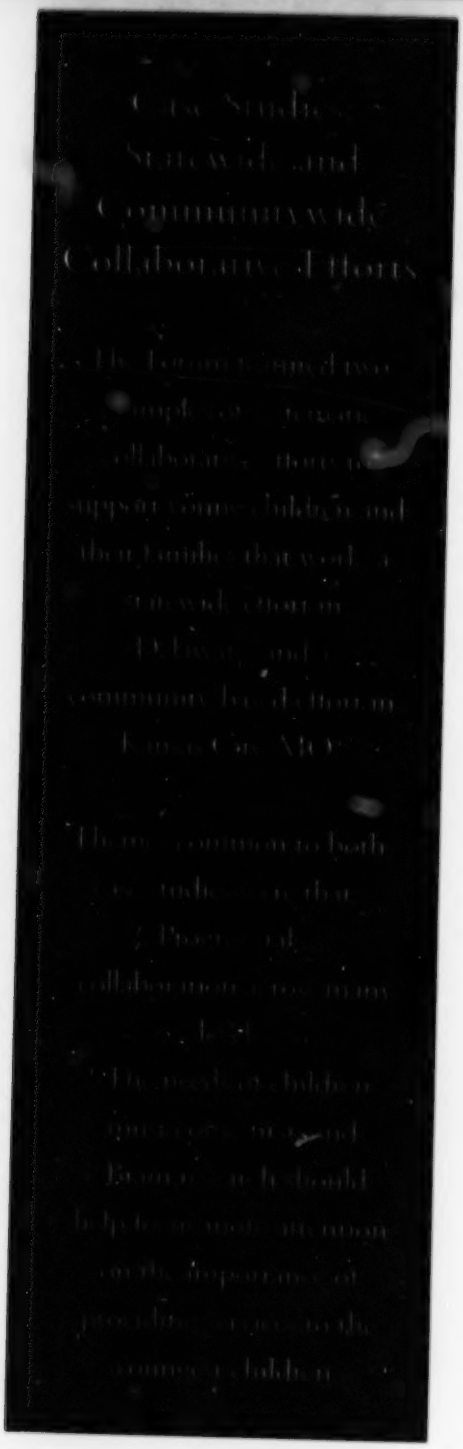

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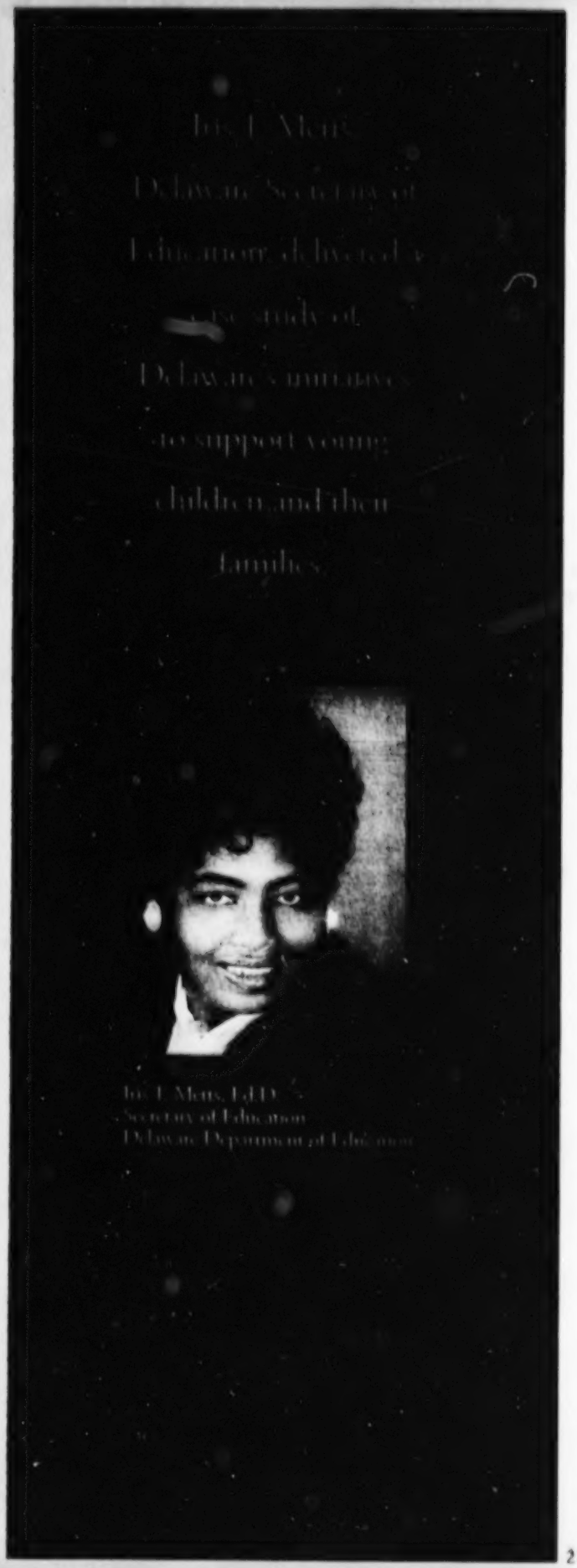

From Cradle To Benchmarks In Delaware

The success of Delaware's model hinges on three factors: leadership, collaboration, and accountability. The Secretary of Education reports directly to the Governor and is part of his Cabinet. That kind of relationship is essential for moving forward any program or policy changes in education.

Governor Tom Carper's leadership has been pivotal to the state's success in addressing early childhood issues. In Delaware, within 72 hours of giving birth, every parent receives a kit containing information on parenting and programs like Parents as Teachers, Head Start, and other social and health services. The state's Secretary of Health and Social Services coordinates that effort, but collaboration among Cabinet secretaries has been critical in launching projects like these. Admittedly, it takes time and effort to set aside egos and competitive attitudes and address families' needs holistically.

One of the keys to Delaware's cohesive approach to children is a special, separate cabinet composed of all of the secretaries whose departments offer direct services to schools and children and families. The purpose of this Family Services Cabinet is to pool the expertise and resources of the various departments that have an impact on children and families, from education and social services to labor and corrections. The cabinet's job is to see if these services are consistent, support one another, and use money in the most effective way. The bottom line is, are we making a difference for children?

Among the Family Service Cabinet's accomplishments are:

- Visiting every newborn baby at the hospital, and getting additional services for those in need.
- Encouraging businesses to extend Parents as Teachers services to their employees.

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• Implementing Head Start programs in schools, community centers, and other neighborhood settings, kicking in state matching funds where needed.
• Establishing a benchmarking process to measure the state's progress in improving conditions for children.
• Working with the University of Delaware to examine the goals and programs of all agencies with an eye to making measurable improvements in services to children in a timely manner.
• Assembling a national database to compare the status of children in Delaware with those across the nation.
• Identifying the most needy communities in the state and concentrating resources in those areas-from preschool education to community policing to substance abuse treatment to working with incarcerated parents.

In January 1998, Governor Carper released the report of an accountability task force charged with assessing how well the public schools are meeting the goal of equity for all students. The report proposed a plan for identifying preschool children who are not ready to enter kindergarten and providing extra services and supports to help them. The foundation must be laid to give all children an equal chance to succeed not just when kindergarten begins, but at birth. We have to demonstrate that the best place to put funding is at the beginning of the cycle. The emerging research on the brain can play a vital role in efforts to focus more funding on the earliest months and years of life.

The Education Commission of the States and other organizations can play an important role in pointing politicians in the right direction when it comes to translating research into action. We're trying to lay a foundation that is so compelling it will be impossible to dismantle.

The bottom line is, are we making a difference for children

Local and State Partnerships Lead The Way In Missouri

The Partnership for Children encompasses not only Kansas City, which has a population of about 1.5 million in the metropolitan area, but two counties in Kansas and three counties in Missouri. One of the partnership's activities involves publishing an annual report card on the status of children, based on 18 benchmarks developed by the community. One of the benchmarks focuses on the quality of child care. Advocacy is another important role for the partnership. As part of a campaign to increase immunization rates the Governor worked with the partnership to send mass mailings to parents providing information and timetables for immunizing their children.

While the state uses a number of models to deliver early childhood care and education, in Kansas City, providers have been working together to try to create a more cohesive system. Several of our initiatives-from community standards to special scholarships and training activities for early childhood providers-are unique to Kansas City.

- The School of the 21st Century program. Besides providing before and after school care, this program provides Parents as Teachers, Medicaid screening, and child care resource and referral services.
- Full Start. Kansas City also has put a unique spin on it's Head Start program by offering to fund Head Start programs in child care centers as long as the providers agree to abide by the Head Start model and compensate its workers accordingly. This effort, called Full Start, is going to be one of the most significant advances to improve quality.
- Caring Communities. Caring Communities is a statewide effort to offer community and school-linked services designed through a comprehensive community process. The initiative is

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administered by a unique conglomeration of agency and philanthropic leaders called the Family Investment Trust. The Trust channels funds blended from several agencies to community partnership groups to plan and design their own school-linked programs.

• Programs focused on setting a higher standard for early childhood care and education. Parents, child-care providers, and other neighborhood leaders in Kansas City have been involved in a process of setting community standards, and the city also has a child care accreditation project designed to expand the number of centers that are accredited by the National Association for the Education of Young Children.

• Initiatives designed to bolster the training and leadership potential of child care personnel. The partnership has set a goal that by the year 2000, every child care setting will have at least one person with a degree in early childhood education.

• Collaborations with Business. Partnership for Children has been working with the Greater Kansas City Chamber of Commerce and other business organizations to raise money to help centers become accredited. Several collaborative organizations have come together under one umbrella to deliver a coordinated message to the community on the value of early-years investments.

Kansas City's leadership has helped guide the Governor's Commission on Early Childhood Care and Education, since seven of the 27 commissioners are from Kansas City. Another advantage the Partnership for Children enjoys is its proximity to the Kansas City regional office of the Administration for Children and Families. If the Partnership needs anything or wants federal government involvement, it's just a three-block walk to talk it over with federal officials.

The media has been a powerful tool for bringing attention to youth issues. The Partnership's belief is that every institution that has anything to do with children-from local organizations to communities of faith to places of employment to schools-must make a commitment to conduct its business with one question in mind: "Is it good for the children?"

Every institution that has anything to do with children...must make a commitment to conduct its business with one question in mind: "Is is good for the children?"

Rob Reiner's "I Am Your Child" Campaign

For the past few years, Rob Reiner has been involved in the "I Am Your Child Campaign." The focus of this campaign is to make people aware of the importance of the first three years of life and to move public policy makers to act on this information.

The Campaign began with the White House Conference held in April 1997, and has included an ABC television special, parenting information, educational videos, and more.

The Campaign is also reaching out to policy makers to try to affect policy geared towards young children. To this end, it is working with the National Governors Association. A ballot initative has been drafted in California to fund the entire state of California for early childhood. The Campaign's goal is to get communities to develop an integrated approach to early child care. Each community would have a resource center that would give every parent and child access to quality care, health care services, parenting education, and intervention programs for families at risk.

The most significant component, however, is parenting education. Parents need to understand the importance of the first three years of development and the critical role parents play in giving their children the best start in life in order to act on this information.

Mr. Reiner applauded the efforts of programs like Parents as Teachers and groups such as the one assembled for this Forum. He commended Forum participants for doing a terrific job promoting awareness of the needs of young children and their families, and urged them to keep up the excellent work.

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The Policy Perspective

Early educators and scientists must work together to provide the best possible information to decision-makers. Policymakers will make decisions with whatever tools they have, and if they don't have good information, they won't make good policies. Here are six points that summarize the main themes and issues that emerged from this Forum:

The quality of children's early environment matters a great deal, and so does the skill and training of parents, care givers, and other early educators. Nonetheless, this nation doesn't direct either its resources or its top talent into early childhood care and education.

Research does influence policy, but it takes too long to happen. We don't have 20 years to wait before we start making the right kinds of investments in early childhood care and education.

Research will influence policy and practice, but policy and practice will also influence research. Scientists must work closely with early childhood educators to determine the kinds of information they need to improve practice. Teacher education programs should not be sending graduates into the profession without this kind of knowledge.

We need new policies to help raise the standard of qualifications and compensation for early childhood care and education providers. And we also need new strategies to evaluate whether changes are producing improved results.

We must avoid oversimplification. As much as we want to sell the message that early intervention matters, there are no magic bullets. We need skilled advocates who can make their case based on facts and research-based information, not hype.

Collaboration needs to happen beyond the Cabinet level. Parents, agencies, and communities need to work together at the level of the individual child. Policymakers' decisions about how money flows can "lock in or prevent turf battles."

The primary goal of public policy should be to make the conditions that result in optimal brain development universal, so that all children, not just a select few, have the kinds of experiences that give them the best shot at success. One of the most difficult challenges this field faces is making sure that everyone-not just the parents who need it least-have access to all the research facts and information.

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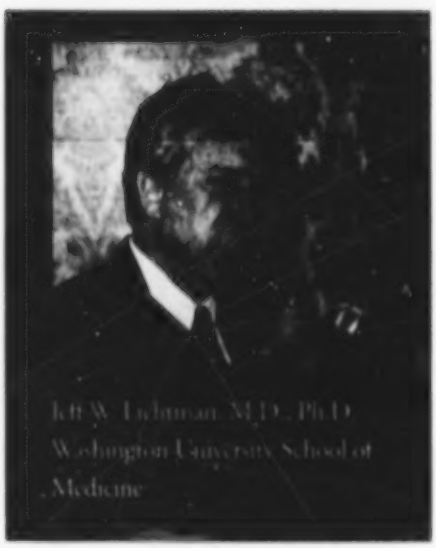
The Neuroscience Perspective

Although the human brain's capacity for learning has not changed, the environment in which human beings are being asked to learn has changed considerably and dramatically in our lifetime. The industrial revolution produced one set of changes, and the information technology revolution is generating another. The brain's makeup is capable of responding to all these changes. Yet we are rapidly approaching the stage where people will not even need to read and write to have access to knowledge and communication, since computers are capable of listening and recording our thoughts and replaying them back to us. All of these developments will have an impact on the teaching and learning enterprise. But as long as we still want to transmit knowledge, we need to be doing it in accordance with how the brain forms, changes and receives information at various stages of development.



Jeff W. Lichtman, M.D., Ph.D.
Washington University School of Medicine

Rather than simply assuming children aren't ready for learning until kindergarten, for example, the education system is going to have to come up with styles of teaching that change as the brain changes.

As the earlier pr[illegible]ntations on language and vision implied, the brain has an incredible amount of flexibility in its developmental stages, and experience essentially causes it to gravitate toward and select certain skills. In summary, the young brain has great potential but not much skill, while the adult brain has great skill but not much potential.

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Putting It All Together: Challenges and Mandates

This forum essentially laid out two broad questions: what do we know about how the brain develops, and what should we do about it? The presentations offered powerful evidence that the early months of development set the stage in important ways for learning, and that early experiences are critical to later outcomes. The roundtable groups universally agreed that the quality of input in the early years matters greatly, and that making sure all children have the kinds of experiences that promote healthy brain development should be a top national priority. Unstinting attention to physical health and nutrition are part of this picture, but children also need "language rich" environments and stimulating experiences to become successful learners.

Windows of Opportunity. Presentations on how the brain is wired and how different areas of the brain "check in and out" to perform various tasks suggest that there may be critical periods for acquiring certain motor and cognitive skills. Some scientists argue that these newer findings are not specific enough to translate into a set of guidelines for how parents should approach their infants or how schools should restructure classes. But many educators and child advocates feel the time is ripe to take what we do know and put it to practical use. The knowledge at our disposal is more than enough, they argue, to support interventions that can reduce the nagging disparities in success rates between children of enriched environments and children of deprivation.

True, we may not be able to pinpoint the precise windows of opportunity or best methods of instruction for reading and mathematics based on our current knowledge of brain wiring. But at a minimum, conference participants suggested, the research should add urgency to our efforts to eliminate the behaviors and hazards that jeopardize children in utero and early infancy. Many also see the emerging knowledge base about brain development as potent ammunition in making the case for investments in interventions such as parent education and family literacy programs. Some participants cautioned, however, against oversimplifying or distorting the research to promote specific educational policies or methods of instruction.

Communication Is Key. Communication, the participants agreed, is essential in putting neuroscience research to productive use. The discussion groups stressed the importance of identifying decision-makers at all levels of government, business, community and civic leadership and educating them about brain development and its policy implications. Conversations with business leaders and politicians, in particular, should highlight the connection between early childhood outcomes and the long-term productivity of the economy. Some participants argued that this information, to the extent possible, should come directly from scientists. Others maintained that skilled "translators" are needed to distill the information for a wide range of audiences.

No sector of society needs clear, cogent information about the critical nature of the early years more than parents. Participants agreed that parenting skills are paramount to raising healthy and literate children, and that schools have an important role to play in teaching today's students-tomorrow's parents-about what it takes to nurture a child. Another area of consensus was that professionals in all fields involving children and families need more training and expertise in the lessons of neuroscience research. Caregivers and early educators top the list of people who need more specialized training in order to provide high quality care to children in their critical early months and years. This knowledge must also become part of the vernacular of teacher education, nursing, social work, and adult education.

Collaboration Among The Disciplines. Beyond just applying the research to their own domains of influence, professionals from a variety of fields have much to gain from

working together to apply the findings of neuroscience research. Such collaborations, forum participants pointed out, can help create not just a "shared language," but a common commitment and coordinated response to improve the outcomes of children. To reach this stage, however, the various sectors and disciplines need to set aside territorialism and turf protection and eke out time to work together for the best and most far-reaching approaches to serve children, families, and communities. There was also a consensus that changes in the way services for children and families are organized could go a long way to improve the quality and effectiveness of those supports.

More Research. What kinds of research do practitioners need in order to apply neuroscience research to their work? Forum participants expressed a hunger for more research about the critical timeframes for learning different skills, and how to make the most of them. They also want to know more about the effects of pernicious chemicals and environmental influences on child development. They are curious about how the brains of children with disorders like autism are wired differently from those of other children, and they want to know what can be done to compensate for the difficulties experienced by children who, for any reason, are not successful learners. They are anxious for information on how the learning patterns of children of different cultural and socioeconomic backgrounds differ, and what strategies work best for children with different learning styles. And they want to ensure that any set of guidelines for applying the findings of neuroscience research take such individual differences into account.

None of these questions can be answered productively, participants agreed, without more sustained and meaningful dialogue between educators and neuroscientists. This forum was a solid first step, but many different kinds of discussions, meetings, and collaborative efforts are needed at the local, state, and national level to turn theory into action. Cognitive scientists, many panelists agreed, should be at the table in all these discussions, and may well be the right intermediaries to help bridge the gap between neuroscience and education. All of these discussions must address and involve many different players in setting standards to hold professionals and programs accountable for results. The federal, state, and local governments all have a role to play in setting standards of accountability, and community leadership and input in this process is also essential. Despite their aversion to the wrong kind of testing and assessment of young children, early educators should assume a leadership role in developing appropriate benchmarks to measure progress in meeting a clearly defined set of objectives for children's health, education, and welfare.

Several participants stressed the need for a "master plan"-a set of strategies to guide policymakers in crafting policies that capitalize on the findings of neuroscience research. This forum did not reach that stage. While there was recognition that children's potential for grasping foreign languages may be most powerful in the earliest months, for example, there was no consensus that promoting language training in preschool should be a primary policy goal for researchers or child advocates. And while the research on brain development reinforces the importance of healthy and nurturing environments beginning at birth, it does not, the scientists caution, warrant a rush to invent some form of accelerated early schooling to help well-educated middle class parents give their children an educational edge.

It makes more sense, forum participants suggested, to focus on improving the quality of early care and education and making sure instructional practices are consistent with what we know about how the brain works. Frank Newman suggested that our efforts be geared toward maximizing the conditions that result in optimal brain development for all children-not just those born into supportive and enriched environments. That goal certainly seems like an appropriate place to start.

List of Presenters

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